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8–11 July 2014

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Executive summary

The ICES Working Group on Large Marine Ecosystem Programme Best Practices (WGLMEBP) met at IOC in Paris, 8–11 July 2014. The meeting format was changed from previous years and the WG met as an integral part of the wider 16th Consultative Committee Meeting on Large Marine Ecosystems and Coastal Partners. The agenda for the wider consultative LME meeting had a strong emphasis on governance practices and tools, networks, capacity development, and communication and outreach. There were four ToRs on the multi-annual program for the WG to consider this year.

ToR a - Information on Integrated ecosystem assessments (IEA), and

ToR b - Synthesis of the most commonly used science-based indicators

There were little information provided at the meeting on the development and use of indicators in the GEF-supported LME projects and on the status of development toward IEA for the LMEs. Information on these issues will be sought through a questionnaire that will be sent to LME projects. The received information will be summarized, evaluated and reported in the 2015 report from the WGLMEBP.

Information is presented on work on the Ecosystem Approach to Management (EAM) and IEA in the Arctic Council for the now 18 Arctic LMEs following the revision of the Arctic LME map in 2013. It is suggested that ICES could be involved in work on methodology and conduct of IEAs and the advice context of such work. Collaboration with AMAP (Arctic Monitoring and Assessment Program) is suggested as a main way that ICES could become more directly involved, possibly facilitated by the PAME-led EAM expert group.

ToR c - Identifying LME units as references for IEA

The revised (2013) map of the Arctic LMEs should be used also by ICES as the basis for IEAs and advice to support the EAM for these ecosystems. There is a need to consider the southern boundaries of the Arctic LMEs in relation to boundaries used for the neighboring boreal and temperate LMEs, e.g. the North Sea and Celtic Seas in the Northeast Atlantic. It is suggested that ICES should use the term LME for analogous 'ecoregions' which qualify as LMEs according to ecological criteria.

ToR e - Identify areas of collaboration and mutual interest between ICES and LME groups

It was noted that ICES has much to offer in terms of training and capacity development for LME projects. Areas where ICES can offer scientific support and advice include traditional fish stock assessments as well as the broader IEAs. The systematic development and experience of the IEA framework in ICES could be a model that could be of substantial value to LME projects worldwide.

The next meeting of WGLMEPB will take place during the LME Consultative Meeting, at IOC, Paris France in July 2015.

1 Introduction and format of the meeting

The meeting of the ICES WGLMEBP was held this year as an integral part of the wider 16th Consultative Committee Meeting on Large Marine Ecosystems and Coastal Partners held at UNESCO-IOC in Paris, 8–11 July 2014. This was a change from previous years when the ICES WG was held as a separate meeting back-to-back with the Consultative LME meeting. The agenda for the wider consultative LME meeting had a strong emphasis on governance practices and tools, networks, capacity development, and communication and outreach. The first day (Tuesday 8 July) the meeting was structured with regional submeetings ('caucuses') for Africa, Asia, Latin America and Caribbean, and Arctic.

The Arctic submeeting was the slot on the agenda where we had the opportunity to address items on the ToRs for the ICES WGLMEBP. The ToRs had been revised as a 3-years plan with expected deliverables for the period 2014–2016 (see Annex 1). Rudolf Hermes, Chief Technical Advisor of the Bay of Bengal LME Project, based in Thailand, had been appointed as a new Co-Chair, replacing Nico Willemse (Namibia).

Due to the integrated nature of the meeting, we did not distinguish members of the ICES WG specifically but have included the full list of participants of the wider LME meeting as Annex 1. A draft version of the report was circulated to the full list of participants for their possibility to provide any additional information and comments.

Two of the ToR items (a and b, see below) relate to collection and synthesis of information on Integrated Ecosystem Assessments (IEA) and use of indicators in the context of the ecosystem approach (EA), or the synonymous term Ecosystem-based management, EBM). In the introduction to the session with regional submeetings on the first day, we formulated some questions which we asked the groups to consider:

LME modules and indicators

- Which indicators are being used (list) and what is the state of development?
- How are the indicators used (or intended to be used)?
- How do they relate to management?

Integrated ecosystem assessment – IEA

- Is IEA carried out or planned?
- What is the state of play re development of IEA?

There were no immediate responses from the groups on these questions, at least partly due to time constraints. We will therefore follow up on these issues with a questionnaire and report the outcome of the synthesis of information at the next meeting of the WG.

2 ToR a – Information on Integrated ecosystem assessments (IEA), and ToR b – Synthesis of the most commonly used science-based indicators

2.1 Concepts and terminology

Integrated ecosystem assessment (IEA) is a key component of the ecosystem approach to management (EA or EAM, or the synonymous term ecosystem-based management EBM). It serves the purpose of making an overall evaluation of the state of the ecosystem including impacts from human activities as a basis for adaptive management interventions to achieve agreed overarching ecological objectives (sustainable use, conservation of biodiversity). A definition of EAM used in European policy context and now adopted by the Arctic Council is: *the comprehensive integrated management of human activities based on the best available scientific knowledge of the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity*.

ICES has defined IEA as: *a synthesis and quantitative analysis of information on relevant physical, chemical, ecological and human processes, to provide the fundamental scientific understanding to support advisory, management and governance needs. (WKBEMIA report 2012)*.

Another definition is provided by NOAA: *IEAs are intended to provide 'a synthesis and integration of information on relevant physical, chemical, ecological, and human processes in relation to specified management objectives (Levin et al., 2008, 2009)'. IEAs therefore draw on both the natural and human-dimensions sciences to determine the status of these coupled Social-Ecological Systems (SESs) and to evaluate management options. This requires coordination and cooperation among different state and federal agencies and drawing on the expertise of partners in native communities, academia, and non-governmental organizations* (http://www.noaa.gov/iea/next-gen-tool.html).

We note that these definitions are broadly similar and in general agreement.

It is important to note that IEA is a broad and complex concept representing a wide spectrum of degree of integration. 'Integrated' is used to distinguish IEA from more narrow thematic or sectoral assessments such as for example single species fish stock assessments, eutrophication assessment, or assessment of environmental impacts of shipping. There is a continuum going from narrowly focused single species assessments to fully integrated assessments including socio-economic information. We can possibly see a sequence or modules through status assessments of ecosystem components (species, communities, habitats), impact assessments of human activities including cumulative impacts, and assessments of socio-economic drivers, impacts and responses of the human society subsystem.

Reflecting the different levels of integration, we could regard IEA as a modular build-up of assessment components. In this context, there exist already a number of different types of assessments such as fish stock assessments, threatened species assessments, and environmental impact assessments or statements (EIAs, EISs). Many of these assessments are mandated by legal requirements. The relationship between the various types of existing assessments and IEA is a topic that needs to be further explored. One issue here is the use of thematic and sectoral assessments as basis for, or components of, IEAs.

2.2 Updates on EA activities in the Arctic region

The PAME (Protection of the Arctic Marine Environment) WG under the Arctic Council established in 2007 an expert group on the ecosystem approach to management in the Arctic (EA-EG). The EA-EG is led by Norway and the USA with Phil Mundy (NOAA, USA) and Hein Rune Skjoldal (IMR, Norway) as co-leads. The group completed last year a revision of the map of the Arctic LMEs which now number 18 (http://pame.is/images/02_Document_Library/Reports_to_Ministers/08_AC_Meeting/Revisions_of_the_Arctic_LME_map.pdf). A 4th EAM workshop was held in Vancouver 16–18 June this year with focus on work to develop IEA for two of the Arctic LMEs: the Barents Sea and the Beaufort Sea. The report from the workshop will be presented to the PAME II-2014 meeting in Whitehorse, Yukon, Canada, in September and will be made available at the PAME webpage (www.pame.is).

The EA-EG will continue work to review progress and promote the development of IEA of Arctic LMEs. Of particular relevance in this context is the work by the AMAP (Arctic Monitoring and Assessment Program) WG on the project AACA-C (Adaptation Actions for a Changing Arctic) which will include IEAs of three selected areas: Barents Sea, Baffin Bay-Davis Strait, and the Chukchi-Beaufort seas. A 5th EAM workshop is planned next year (2015) where the focus will be on the issue of setting ecological objectives for Arctic LMEs.

The Arctic Council ministers established an EBM expert group in 2011 and this group delivered their report to the ministerial meeting in Rovanjemi, Finland, in May 2013. The EBM expert group proposed a definition for EBM (or EAM), suggested a number of principles inherent in EBM, and made several recommendations for follow-up activities that were adopted by the ministers (http://www.arctic-council.org/index.php/en/document-archive/category/87-expert-group-documents).

PAME published in 2013 the report Arctic Ocean Review which contain a review of policies and legal instruments available nationally and internationally to deal with environmental issues and challenges in the Arctic (http://pame.is/images/02_Document_Library/Reports_to_Ministers/08_AC_Meeting/AOR_final_report_15_May_2013.pdf).

2.3 Possible involvement of ICES in IEA work in Arctic LMEs

ICES scientific activities focus on the North Atlantic and adjacent European seas, as well as the Arctic Ocean. ICES has signaled an interest to be more strongly involved in Arctic science. A topical area where ICES could have an important contribution to offer is on the basic methodology and conduct of IEAs as well as the advisory interface where the outcome of IEAs are used as the basis for scientific management advice. In this regard, it is important to note that the Arctic geographical area as used by the Arctic Council includes the boreal and Subarctic seas in the Northeast Atlantic (Barents Sea, Norwegian Sea, Iceland Sea) where ICES is already providing advice on fish stocks and fishery management. The new ICES WGs on IEA for the Barents and Norwegian seas (WGIBAR and WGINOR) are relevant ICES activities to prepare the basis for ICES involvement in assessment and advice for EAM for these two LMEs.

All the eight Arctic states of the Arctic Council are also ICES Member Countries. The Arctic Ocean is part of the work area for ICES, and involvement of ICES in the development of regular IEAs for the LMEs in the High Arctic would be welcome. These LMEs are in or around the periphery of the Arctic Ocean basin (Kara Sea, Laptev Sea, East Siberian Sea, Beaufort Sea, Canadian High Arctic-North Greenland, and Central

Arctic Ocean LMEs), and they form an integral part of the larger climatic, oceanographic and biological system of the Arctic Mediterranean Sea. For the LMEs in the Pacific sector of the Arctic (East Bering Sea, West Bering Sea, Aleutian Islands, and Northern Bering-Chukchi Seas LMEs) ICES could also contribute to work on IEAs, possibly in cooperation with PICES.

AMAP, the Arctic Monitoring and Assessment Program under the Arctic Council, would be an obvious partner for ICES in developing IEAs for the Arctic LMEs. AMAP has carried out comprehensive and detailed assessments of pollution status and climate change in the Arctic for the marine as well as terrestrial and freshwater environments. AMAP has also carried out an extensive assessment of oil and gas activities in the Arctic including identification of ecologically important and vulnerable areas in all of the Arctic LMEs. Currently AMAP is carrying out the AACA-C project (Adaptive Actions for a Changing Arctic, part C) which includes integrates assessment for three pilot areas, the Barents Sea, Baffin Bay-Davis Strait, and Bering-Chukchi-Beaufort seas. There is already collaboration between ICES and AMAP since ICES has for many years served as the data centre for AMAP for contaminant data.

The CAFF (Conservation of Arctic Flora and Fauna) WG under the Arctic Council has developed a Circumpolar Biodiversity Monitoring Program (CBMP) with networks of experts on groups of biota. This biodiversity component and the groups of experts are supplementary to the monitoring and assessment work by AMAP and needs to be integrated with the AMAP work for the purpose of IEA.

The EA-EG led by PAME is a coordinating and promoting mechanism for the development of the EAM including IEA for the Arctic LMEs. This group can facilitate the cooperation of ICES with other parts of the Arctic Council 'machinery' regarding the development of IEAs for Arctic LMEs.

2.4 Updates on IEA activities in lower latitude regions

An initial search for IEAs in tropical LMEs has not been successful so far. The characterization approach developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) through a series of projects of Australia's regional marine planning program in identifying "Key Ecological Features and Australia's Marine Protected Areas" can be considered as an alternative in relatively data-poor situations. One example is the Northwest Australian Shelf LME (Northwest Cape to Port Hedland)[1], and this work was followed by several additional characterization initiatives of Australian waters[2]. The CSIRO team has recently started collaborative work with the

[1] V. Lyne, M. Fuller, P. Last, A. Butler, M. Martin and R. Scott. 2006. Ecosystem Characterization of Australia's North West Shelf, Technical Report No. 12. www.cmar.csiro.au/nmsjems/reports/nwsjems_tr12.pdf

[2] Information on the conceptual approach and application to study the trophic systems of the North West Shelf of Australia:
http://www.environment.gov.au/coasts/mbp/publications/north-west/pubs/nw-trophic-systems.pdf
Application to Eastern Australia:
http://www.environment.gov.au/coasts/mbp/publications/east/pubs/ecosystems.pdf
Application to the tropical islands of Christmas Island and Cocos (Keeling) Islands:
http://www.environment.gov.au/coasts/mbp/publications/north-west/pubs/conservation-christmas-cocos.pdf

Bay of Bengal LME for a similar ecosystem characterization. The original approach to collate and validate habitat information and develop a consistent hierarchical description of habitat distributions has been expanded to include parameters of all five LME assessment modules.

Other candidate sites among subtropical LMEs for full IEAs appear to be the Gulf of Mexico LME and the California Current LME, but this remains to be validated.

2.5 Questionnaire to collect information on IEA and use of indicators in LME projects

The LME projects supported by GEF follow an approach with 5 modules and indicators as a basis for assessment and management. The 5 modules are productivity, fish and fisheries, ecosystem health, socio-economics, and governance[3] (Sherman 2005). The 15 or so LME projects (which together comprise almost 50% of the global fisheries) represent a comprehensive empirical basis for evaluating the strengths and limitations in use of indicators for the purpose of assessment and management actions in marine ecosystems. A particular issue is how the indicator-based approach serves the purpose of IEA, or how it may represent the basis for development towards an IEA.

A list of questions was presented at the introductory part of the session on regional caucuses, and the regions were requested to provide initial feedback to these questions. We have also elaborated a written questionnaire (Annex 2) that will be sent to the LME projects for their consideration and response. The questions are in short version:

- Which indicators have been (or are being) developed?
- What is the state of their development (have they been developed and taken in use or are they under development)?
- How are the indicators being (or intended being) used? (How are they being reported? Are they used singly or combined into a holistic context? How do they form the basis for scientific advice? How do they inform management decisions?)
- Is an IEA prepared (or planned) as part of the implementation of EAM/LME projects? (What is the level of integration - ecosystem components, human pressures and impacts, socio-economics?)

[3] Sherman, K. 2005. A modular strategy for recovery and management of biomass yields in large marine ecosystems. *In*: Levner E., Linkov I., Proth J-M., editors. Strategic Management of Marine Ecosystems. The Netherlands: Springer. Pp. 65–80.

3 ToR c – Identifying LME units as references for IEA

The boundaries of the Arctic LMEs were revised and agreed by the Arctic Council in 2013 (insert link to report on PAME webpage). The Arctic area as defined for use in the Arctic Council extends south to about 60˚N in the Northeast Atlantic and includes some of the major fisheries areas where ICES provides advice including the Barents, Norwegian and Iceland seas. It is suggested to use the LME units identified for the Arctic as the basis also for ICES work as contributions to IEAs for the Arctic LMEs. In this regard, it should be noted that the LME boundaries for the Norwegian and Barents seas are used by the two ICES WGs on IEA for those LMEs (WGINOR and WGIBAR;)

The southern boundary of the Norwegian Sea LME and the southern and eastern boundaries of the Faroe Plateau may have to be looked into to ensure consistency with boundaries of LMEs or ecoregions south of the Arctic area, which are the North Sea and the Celtic Sea.

In the Northwest Atlantic and south of Iceland, the southern boundaries of the Arctic LMEs (Iceland Sea and Shelf, Canadian Eastern Arctic-West Greenland, and Labrador-Newfoundland) are towards open sea in the Irminger Sea and Labrador Sea areas where no LMEs (or equivalent ecosystem units) have yet been identified. This could be looked into to see if it would be advantageous to have ecosystem delineation for the Irminger Sea and Labrador Sea according to LME criteria. These sea areas are part of the Subarctic gyre system and are bounded by strong oceanographic discontinuities towards the temperate zone of the North Atlantic.

4 ToR d – Ecosystem overviews for LMEs in the ICES core areas, the Arctic, and other regions

This is an activity that will be informed by the results of the questionnaire survey and carried out over the next two years. We will do an initial scoping in collaboration with LME partners to see how this could be addressed for the LMEs covered by the LME projects in Africa, Asia and Central and South America. We will also consult with the regional groups for IEA in ICES to coordinate activities and avoid duplication of work.

5 ToR e – Identify areas of collaboration and mutual interest between ICES and LME groups

Items included in the discussion were knowledge transfer, capacity development, and communication. These were items identified for discussion and suggestions at the regional group meetings (caucuses) at the wider LME meeting.

It was noted that ICES has much to offer in terms of training and capacity development. The need for fish stock assessment training, using risk-based methods under an ecosystem approach for example, has been identified in the South and Southeast Asia regions, based also on repeated requests received from countries (APFIC 2014)4, and there is also consensus that the science-policy interface can best be addressed through provision of communication training, initially for scientists. ICES could establish linkages with Regional Fisheries Bodies and Regional Fisheries Management Organizations to respond to these identified needs.

It is important to provide information on ICES groups and activities to the wider LME community. It was noted that by participating in ICES courses or WG meetings, the participants from LME projects would benefit by contacts and networks of experts from the ICES community that they subsequently can use actively in their work.

Areas where ICES can offer scientific support and advice are in fish stock assessments and the broader IEAs. ICES has a long tradition of carrying out stock assessments and providing advice to fisheries management. The process and methodologies of doing IEA are still under development in ICES and we are in a phase of learning by doing ourselves. More information on activities in ICES is given in the following.

5.1 ICES Mission and science of interest to LME development

ICES is committed to building a foundation of science to improve ecosystem understanding. This is achieved by coordinating marine monitoring and research in order to advice commissions and governments on marine policy and management issues. The mission of ICES is to provide information and knowledge of the sustainable use of marine ecosystems.

There are a number of Steering Groups and Experts Groups of interest to the scientific development in LMEs.

The SCICOM Steering Group on Integrated Ecosystem Assessments (SSGIEA) coordinates quantitative evaluations and synthesis of information on physical, chemical, ecological, and human processes, providing an improved scientific understanding for ICES to deliver advice on societal trade-offs between different policy options. SSGIEA currently oversees IEA Working Groups in the Baltic (WGIAB), North Sea (WGINOSE), Northwest Atlantic Regional Sea (WGNARS), Western European Shelf Seas (WGEAWESS), Norwegian Sea (WGINOR) and Barents Sea (WGIBAR). The groups were formed by learning from each other, which rapidly evolved the network of groups. The systematic development and experience of the IEA framework in ICES could be a model that could be of substantial value to the LME projects worldwide.

[4] ASIA–PACIFIC FISHERY COMMISSION Thirty-third Session Hyderabad, India, 23–25 June 2014 Summary recommendations of the 5th APFIC Regional Consultative Forum Meeting

The groups can be studied in detail via the ICES webpage http://www.ices.dk/explore-us/Action%20Areas/Pages/ICES-Eco-regions.aspx

ICES science also includes a SCICOM Steering Group on Ecosystem Processes and Dynamics (SSGEPD) and a SCICOM Steering Group on Ecosystem Pressures and Impacts (SSGEPI).

The above mentioned science groups build on a long-term foundation of monitoring programmes with high quality data delivery, survey planning and guidelines overseen by the SCICOM Steering Group on Integrated Monitoring and Observations (SSGIEOM).

The ICES Data and Information Management Group oversees the ICES marine Data Programme which has been accredited with 'Associated Data Unit' (ADU) status within the Inter-governmental Oceanographic Commission (IOC) and the International Oceanographic Data and Information Exchange (IODE). This means that the work of ICES will become more visible in the international setting, and it brings in a more global approach to the work on data exchange.

In addition to the scientific and advisory work, ICES also gives a number of high quality training courses. The training is firmly rooted in the experience and knowledge of the ICES networks. The training provided by ICES is set in a relevant scientific context, and the trainees get the best available instructors and a curriculum, which is adopted, to the needs of the students. Often the training is based on real life examples brought by the students together with their own data. By attending a course by ICES, the students also develop their own network.

Examples of courses:

Stock Assessment (Introduction)

Stock Assessment (Advanced)

Opening the box: Stock Assessment and Fisheries Advice for Stakeholders, NGOs and Policy-makers

Social Science Methods for Natural Scientists

Marine Spatial Planning: Processes and Tools

Trawl Survey Design and Evaluation

Design and analysis of statistically sound catch sampling programmes

Communicating Science and Advice

Approaches to the Integrated Assessment of Status and Trends in Marine Ecosystems

A full list of ICES courses can be found at the website: www.ices.dk/news-and-events/Training/Pages/default.aspx

Annex 1: List of participants of the 16th Consultative Committee Meeting on Large Marine Ecosystems and Coastal partners

XVI Consultative Committee Meeting on Large Marine Ecosystems and Coastal partners.

Paris (FR) 8-11 July 2014 **UPDATED 10 JULY 2014**

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Annex 2: Draft Questionnaire on use of indicators and IEA in LME projects

The Large Marine Ecosystem (LME) projects supported by GEF follow an approach with five modules and numerous indicators as a basis for assessment and management. The five modules are productivity, fish and fisheries, ecosystem health, socio-economics, and governance.

The 15 or so LME projects (which together comprise almost 50% of the global fisheries) represent a comprehensive empirical basis for evaluating the strengths and limitations in use of indicators for the purpose of assessment and management actions in marine ecosystems. A particular issue is how the indicator-based approach serves the purpose of Integrated Ecosystem Assessments (IEA), or how it may represent the basis for development towards an IEA.

The Working Group of LME Best Practices (WGLMEBP) of the International Council for the Exploration of the Sea (ICES) is gathering information about past and current IEAs into an inventory of IEAs, their geographic scope or scale, and the reference points used.

ICES has defined IEA as: *a synthesis and quantitative analysis of information on relevant physical, chemical, ecological and human processes, to provide the fundamental scientific understanding to support advisory, management and governance needs.* We note that there is a continuum from more narrowly focused assessments, such as of the status of a species, to the fully integrated ecosystem assessment including socio-economic information. 'Integration' should be seen in an incremental context with a modular build-up of assessment components (e.g. fish stock assessments, pollution assessment, etc.) into a fully integrated IEA.

Please assist the WGLMEBP by responding to the following questions (by (date to be set in autumn) 2014):

- Which indicators have been (or are being) developed?
- What is the state of their development (have they been developed and taken in use or are they under development)?
- How are the indicators being (or intended being) used?
    - How are they being reported?
    - Are they used singly or combined into a holistic context?
    - How do they form the basis for scientific advice?
    - How do they inform management decisions?
- Is an IEA prepared (or planned) as part of the implementation of EAM/LME projects?
    - What is the level of integration - ecosystem components, human pressures and impacts, socio-economics?

Please respond to these questions even if you use different approaches to assessments, use different terminologies, or cover only selected themes/parameters in your assessment. Please also contact the two Co-Chairs of the WGLMEBP (Rudolf Hermes and Hein Rune Skjoldal) if there are questions or issues that should be discussed to improve the outcome of the questionnaire.